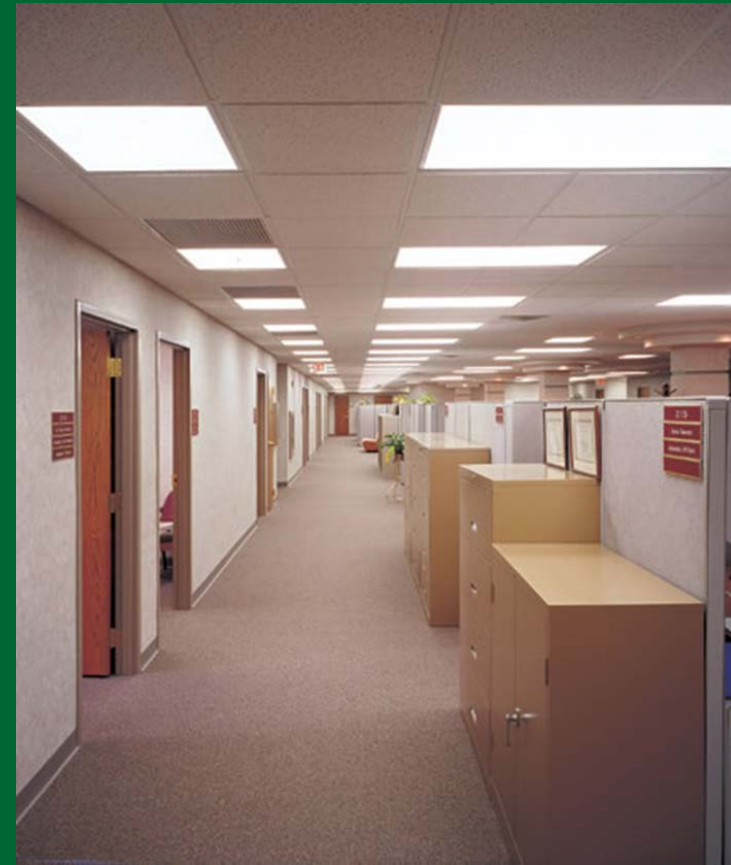


Tubes, Kits, Luminaires: Weighing the Options



LightFair

June 5, 2014

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Pacific Northwest National Laboratory

What's the difference between *retrofit* & *replacement*?

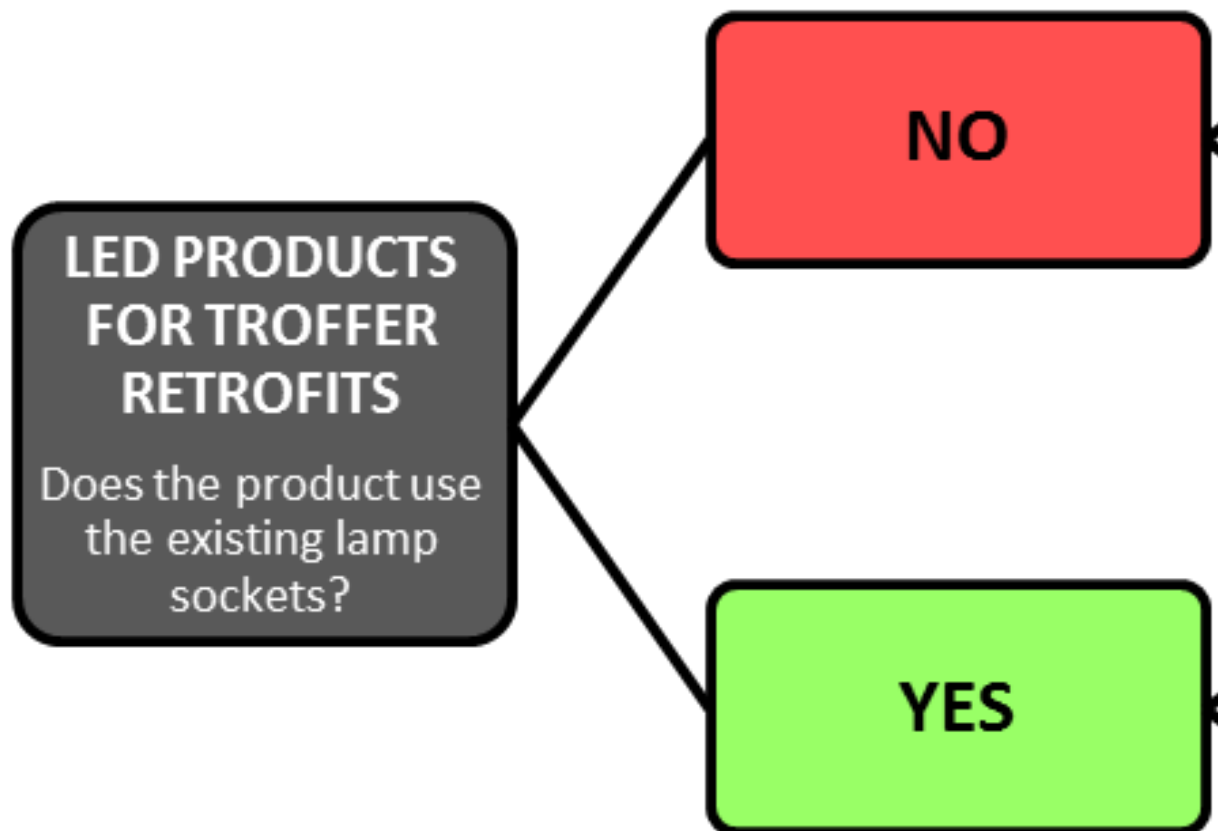


LED replacement lamps

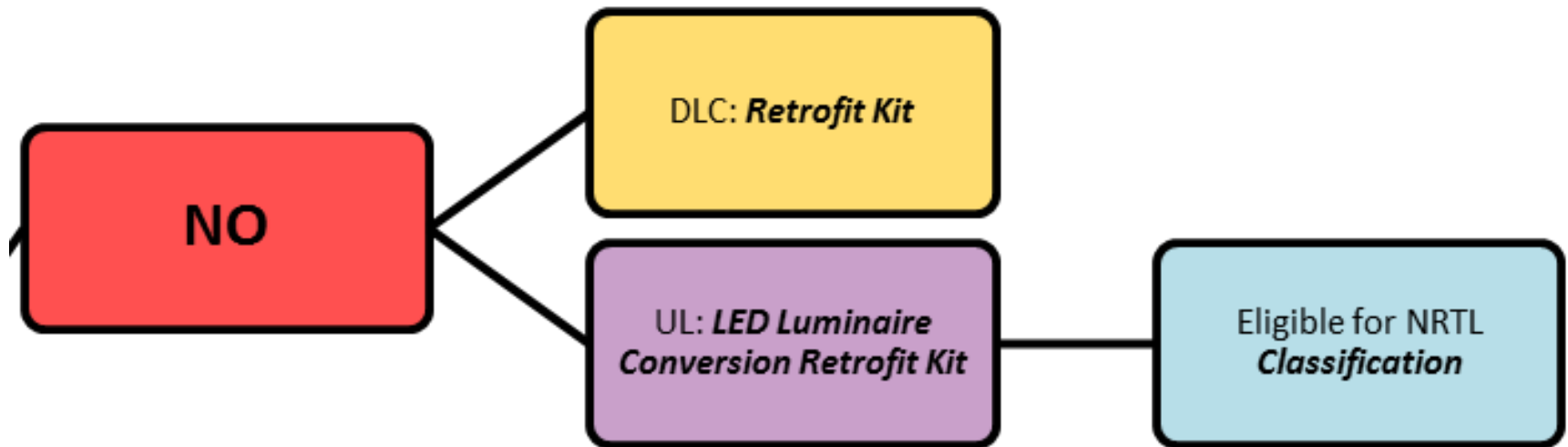


LED retrofit kit

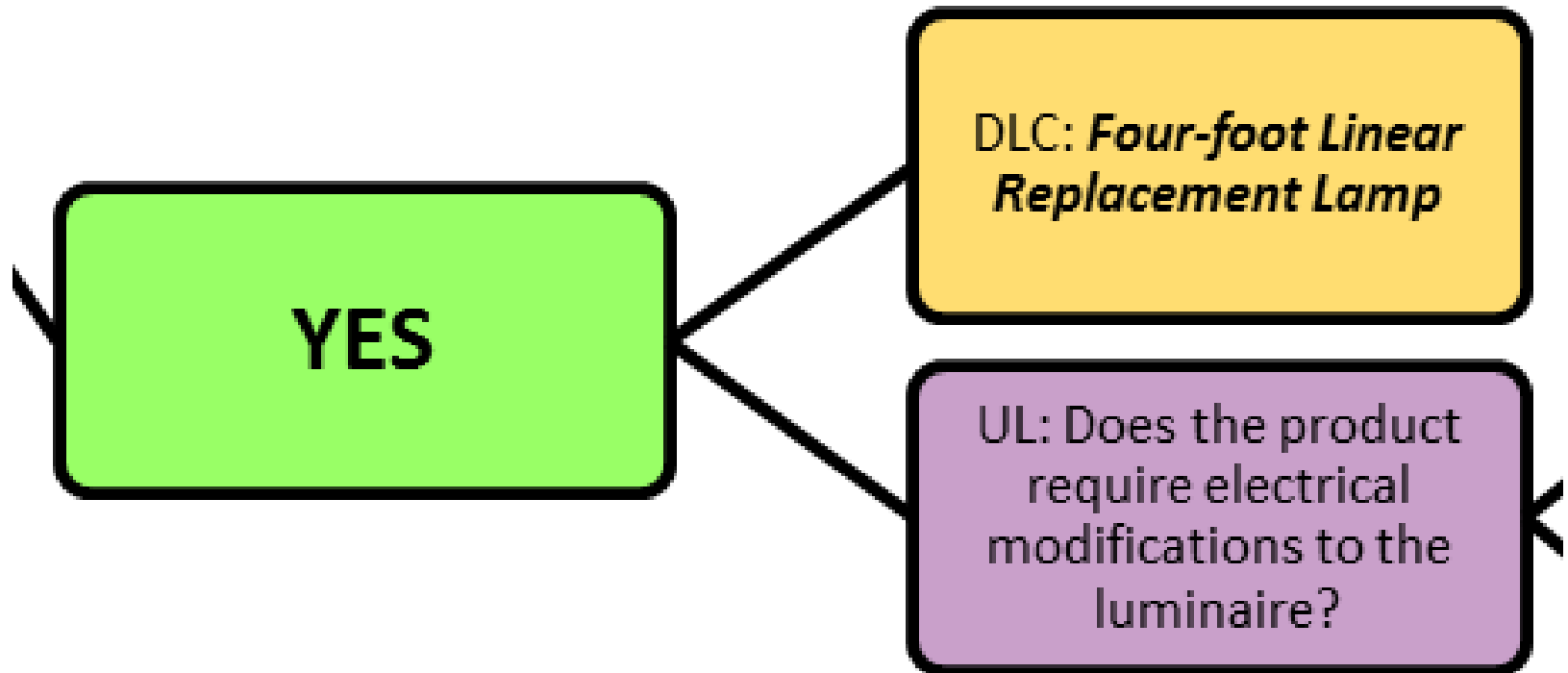
LED Retrofit Options: Terminology & Safety Certifications



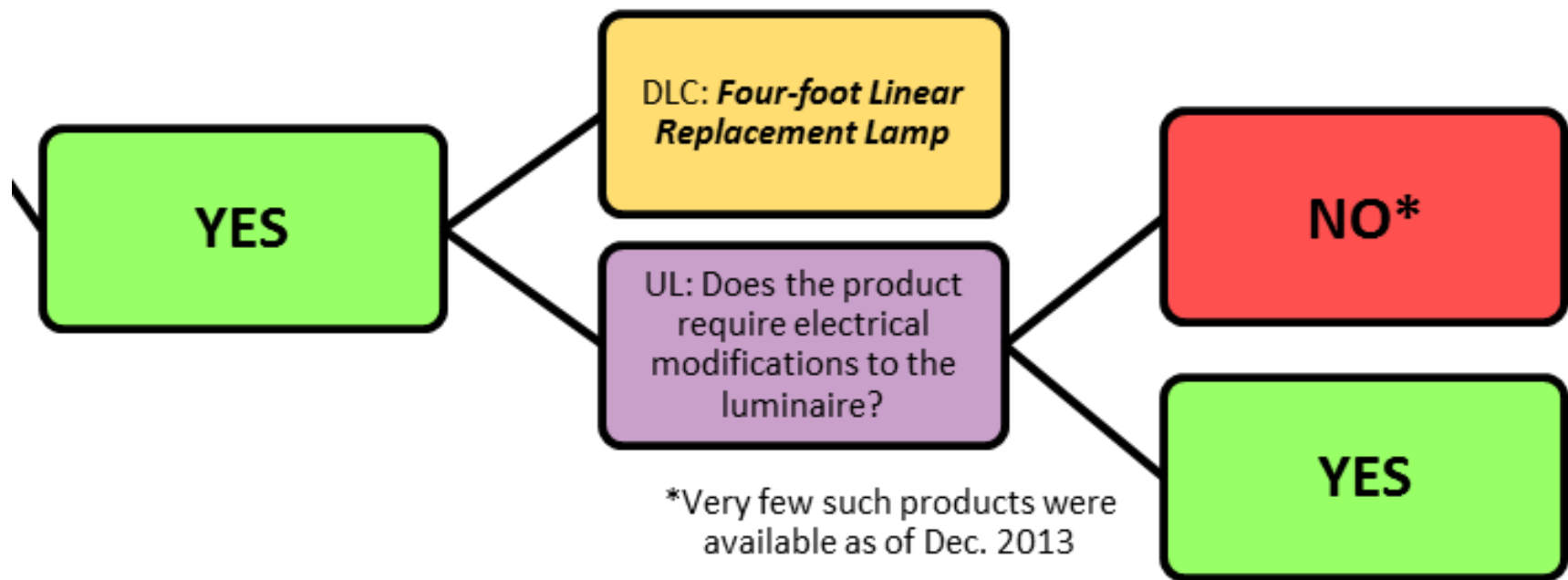
LED Retrofit Options: Does it use existing sockets?



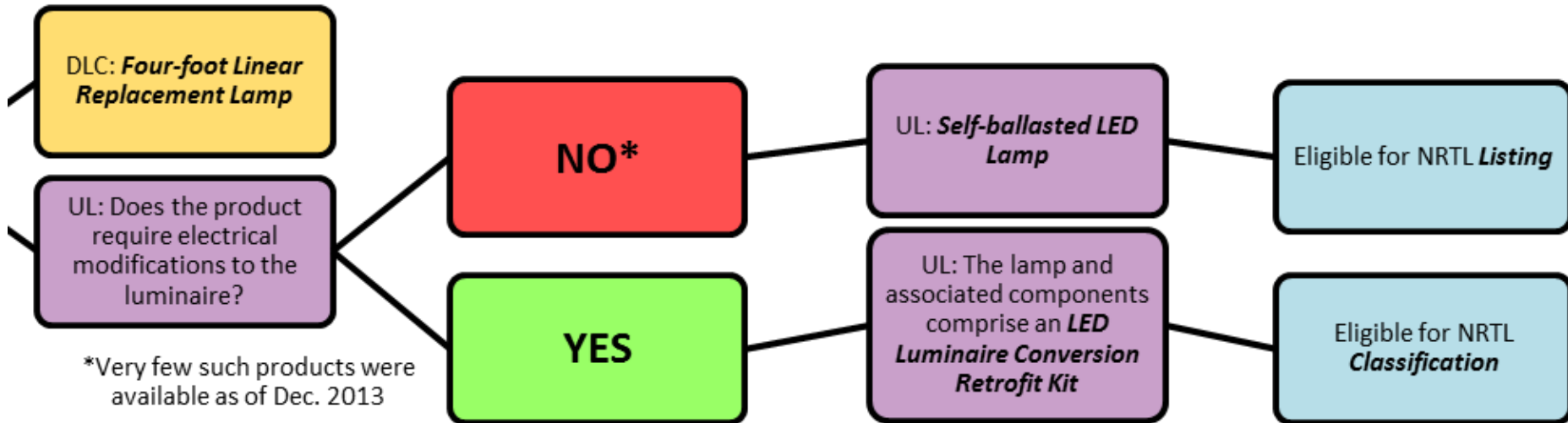
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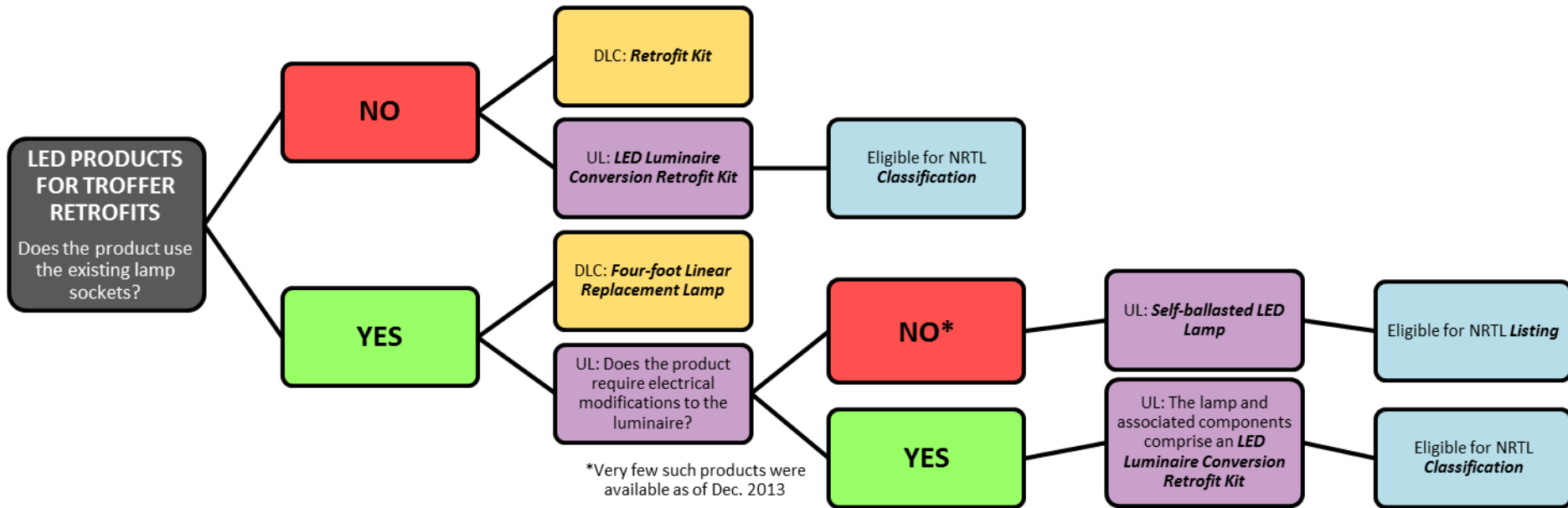
LED Retrofit Options: Does it use existing sockets?


















LED Retrofit Options: Uses the existing sockets















LED Retrofit Options: Terminology & Safety Certifications












System factors to consider for LED upgrades

SYSTEM FACTORS TO CONSIDER	DESCRIPTION	LAMPS	KITS	LUMINAIRES
Initial costs	Equipment purchase costs			
	Installation labor costs			
	Safety certification costs			
Operating costs	Energy costs for equal light output			
	Replacement costs over system life			










System factors to consider for LED upgrades

SYSTEM FACTORS TO CONSIDER	DESCRIPTION	LAMPS	KITS	LUMINAIRES
Current light levels	Acceptable; should not be reduced at all			
	Reductions of 10% or more are okay			
Dimming required	No, dimming is not required			
	Yes, dimming is required			










Existing conditions to consider for LED upgrades

EXISTING CONDITIONS TO CONSIDER	DESCRIPTION	LAMPS	KITS	LUMINAIRES
Condition of sockets	Look like new			
	Some wear but no major cracks			
	Look old, blackened, cracks apparent			

Existing conditions to consider for LED upgrades

EXISTING CONDITIONS TO CONSIDER	DESCRIPTION	LAMPS	KITS	LUMINAIRES
Condition of interior surfaces	Nice and white			
	Slightly worn but no major scratches or peeling paint			
	Very worn, scratches in paint, some peeling paint			

Existing conditions to consider for LED upgrades

EXISTING CONDITIONS TO CONSIDER	DESCRIPTION	LAMPS	KITS	LUMINAIRES
Condition of lens or louvers	Looks new; very little wear apparent			
	Some minor color variations or scratches in surface			
	Looks old, obvious cracks or yellowing			

Existing conditions to consider for LED upgrades

EXISTING CONDITIONS TO CONSIDER	DESCRIPTION	LAMPS	KITS	LUMINAIRES
Ceiling access	No concerns with working above the ceiling; easy access	●	●	●
	Some concerns about working above the ceiling; limited access	●	●	▲
	Working above the ceiling should be avoided	●	▲	■

Tubes, Kits, Luminaires: Should you Upgrade?



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LED Tubes, Kits, Troffers: Should You Upgrade?

Economic questions:

- Electric rate? 6c, 12c, 18c, 24c per kWh? (Demand charges?)
- Annual hours of operation? (2000, 4000, 8000?)
- Cost of relamping?
 - Hard-to-reach or hazardous areas
 - Visually prominent areas
 - Places with expensive labor



If any of these numbers are high, efficient LEDs make more sense
Return on investment highly related to before/after power difference.

What's your existing troffer?

- Find out exactly what make/model is installed in your building.
- T12 or T8 lamps? Lamp wattage?
- Magnetic or electronic ballast?
- Rapid-start, Instant-start or programmed rapid-start ballast?
- What are the input watts and light output?

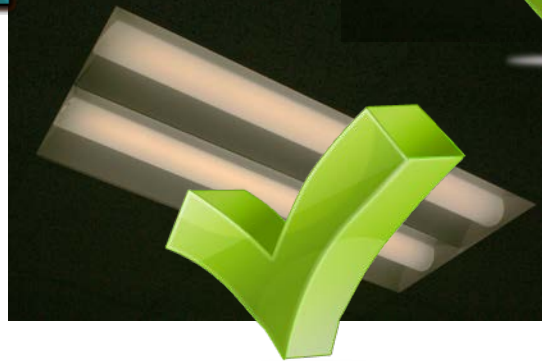
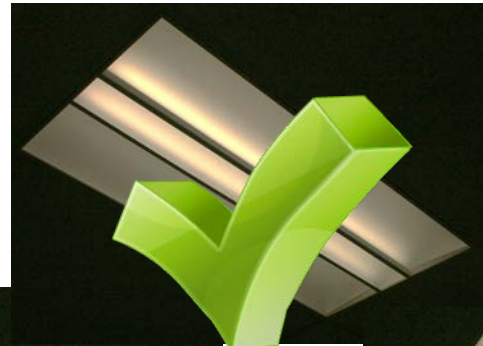
The answers are needed to investigate options.



LED Tubes, Kits, Troffers: Should You Upgrade?

More questions about your troffers....


- Do you want a reduction in light output? If so, can this be more easily and inexpensively accomplished with a low-output fluorescent lamp change, a low-output ballast change or delamping?
- What is the condition of the luminaire and its sockets? If it is in very poor shape, consider a new LED troffer or a full LED retrofit kit instead of lamp retrofits.
- Is this a troffer type where T8 LED lamps make sense?




LED Tubes, Kits, Troffers: Should You Upgrade?

Do your homework:

- Study the product literature of the LED troffers/kits/lamps. Look for wiring diagrams (for compatibility with existing troffers), lumen output, input watts, color rendering index, CCT, light distribution from the lamp or luminaire, NRTL Listings, and warranties.
- Check for DLC listing.



The Original LED Fluorescent Tube Upgrade™



MK2 TUBE SERIES
T8 LED Lamp Specifications

The TOGGLED MK2 LED tube series are mercury-free and energy efficient, designed to work in standard T8 and T12 fluorescent tube fixtures. MK2 LED lamps run directly off of building line power utilizing a calibrated internal driver—eliminating ballast systems and external drivers—to deliver high quality commercial lighting solutions that use less energy than traditional fluorescents.

FEATURES AND SPECIFICATIONS

- Made in Troy, Michigan, USA
- T12 and T8 fluorescent tube commercial retrofit system
- Voltage 120-277VAC 50-60Hz, designed for direct connection to building AC power
- Less than a 2 year payback for high-demand applications
- Eligible for available state and energy credit programs and incentives
- Available in nominal CCT of 3500K, 4000K, and 5000K (Other color temperatures available upon request)
- UL Classified to UL1598C (U120110KR / U120110KM)
- IES LM-79, IES LM-80, IES TM-21 tested
- Suitable for damp locations
- Lifetime rating of 50,000 hours
- 5-year warranty


PATENT NUMBERS

Please visit toggled.com/patents

FACTORY CONTACT


For additional information about our products, please contact:

TOGGLED
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Troy, Michigan 48063-4641 USA
(248) 614-2400 Ext. 332
Fax: (248) 282-2956
info@toggled.com
toggled.com



As a Altair Company

RILEDRI
LED Relighting for Lensed Troffers



Intended Use
The RILEDRI Relight assembly combines digital LED lighting and controls technology capabilities with patented high-performance optical design to offer the most advanced retrofit solution available for general ambient lighting applications. High-efficiency light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable. The RILEDRI is suitable for quick, simple retrofit into nearly any existing deep-cell parabolic or lensed troffer fluorescent fixtures (see dimensional requirements).

Construction
The relight assembly consists of four basic component parts that easily install into the host fixture.
End brackets are heavy-duty powder-coated steel and are attached securely to the host fixture with included hardware. These brackets provide all of the support and adjustment points for the light engine and trim assemblies. End brackets flanges have white finish to match lensed troffer coverframes. White flange trim kit is included for neater appearance.
The light engine serves as the reflector system and head-sink and is finished in high-reflectance white powder paint. To reduce time and labor for installation, all electrical components are shipped installed and pre-wired on the light engine for simple electrical connection via the installed driver quick disconnect. A universal trim assembly provides reflector and refractors for volumetric performance and architectural aesthetics. Housed and recessable RETS (reflective) reflector is firmly attached to the universal bracket via hinge and latch assembly. Included in the assembly are two prismatic acrylic refractors with light-diffusing finish for even illumination and LED obscuration.
A steel splice box accessory is included with the kit for use when required by non-standard retrofit wiring conditions.

Optics
Volumetric illumination is delivered by creating an optimal mix of light to walls, partitions, vertical and horizontal work surfaces—rendering the interior space, objects and occupants in a more balanced, complementary luminous environment. Light distribution is carefully controlled at high angles, providing just enough luminaire flux to create the volumetric effect.
Linear faceted reflector cavity softens and distributes light into the space while minimizing luminous contrast between the fixture and ceiling.
Recessed two-piece reflector system obscures and integrates individual LED images and uniformly illuminates the reflector cavity with light.
Slotted end panels provide a smooth, luminous transition between fixture and ceiling while enhancing the perception of fixture depth.

Electrical
Long-life LED, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. RILEDRI is rated to deliver LED performance for 50,000 hours. LED Accessories™ driver delivers full-range dimming from 0-10V control signal. Driver disconnect provided where required to comply with US and Canadian codes.

Installation
Trim hinges from either side and latches securely with cam-action latches. LED access by hinging trim down to 90°, providing tool-less access to light engine. For tool-less access to driver, twist Latch/Latch and hold trim engine down. LED boards include plug-in connectors for easy replacement or servicing. Suitable for use in host fixtures rated for static or many air-handling functions. (Consult factory for details on air-handling compatibility.)

Listings
UL Classified to meet retrofit standards and requirements. Protected by one or more of US Patent Nos. 7,228,192; D541,487; D541,488; D544,833; D544,834; D544,992; D544,933 and additional patents pending.

Product Overview

Specification Sheets

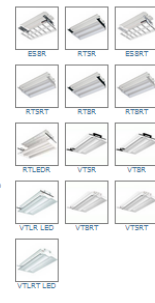
Photometric Data

Request Building Information Models

Additional Images

Questions about this product?

Related Products



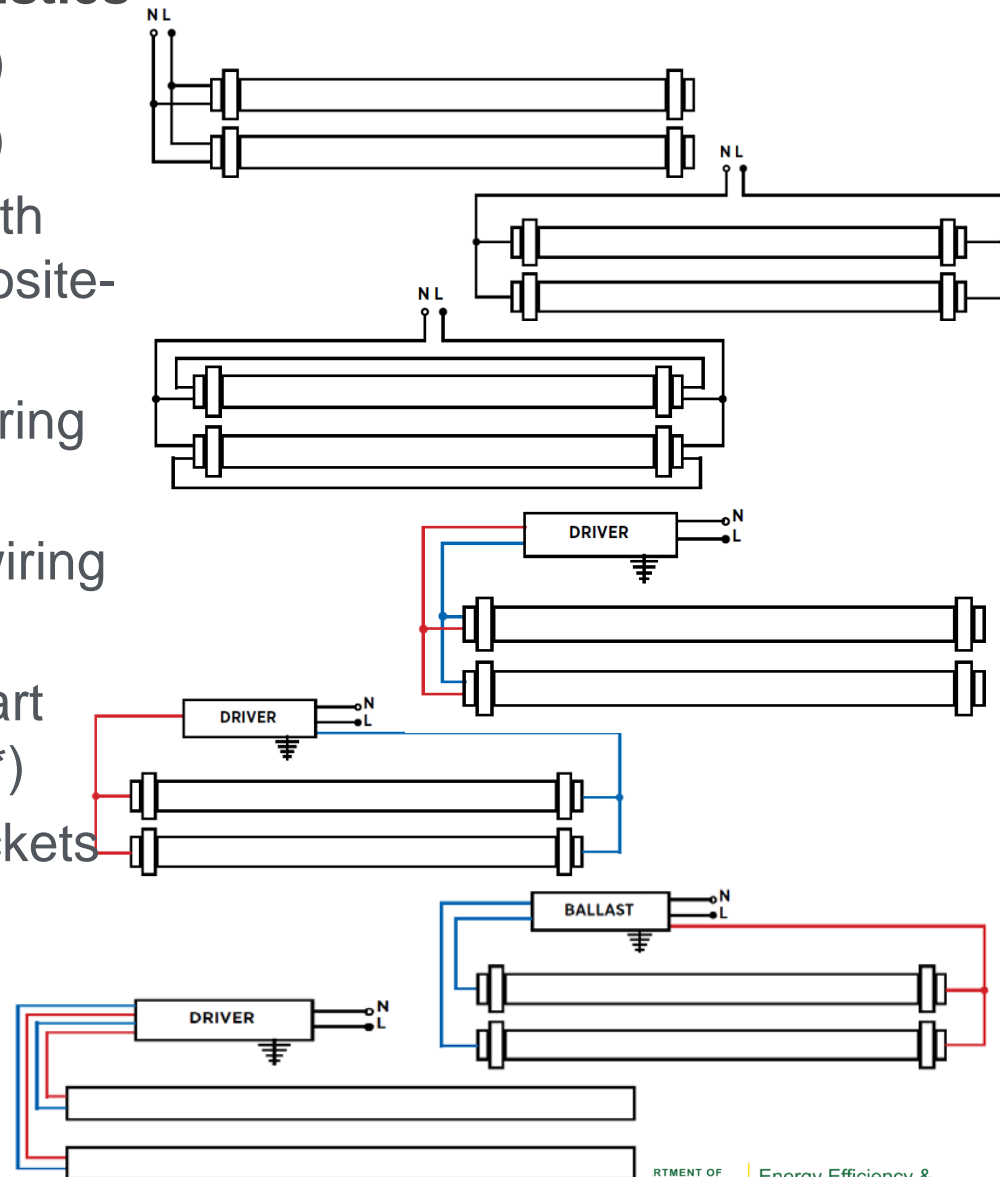
LED Tubes, Kits, Troffers: Should You Upgrade?

LED T8 Wiring/electrical characteristics

1. Line voltage single end wired (**)
2. Line voltage double end wired (*)
3. Line voltage double end wired with additional wire between two opposite-end pins (**)
4. Remote driver with single-end wiring (**)
5. Remote driver with double-end wiring (*)
6. Operates with existing instant-start fluorescent ballast and sockets (*)
7. Operates without fluorescent sockets

* Instant-start or *shunted* sockets req'd

** Rapid-start or *unshunted* sockets req'd



LED Tubes, Kits, Troffers: Should You Upgrade?

Do your homework:

- Get enough lamps/kits/troffers for 4-8 luminaires and bring in electrician to rewire the luminaire (if needed). Get electrician feedback on the **ease of the retrofit** and the **time/cost** involved. Also get feedback from staff on the appearance/glare/color quality of the modified luminaires. Is it an acceptable change? Is it ugly? Is it glaring? Does it look nifty?



- Check for flicker, especially if it's dimmed.
- Do the Life Cycle Cost analysis.

LED Tubes, Kits, Troffers: Should You Upgrade?

If you use T8 LED tubes:

- Rules-of-thumb: If you want roughly equivalent performance to 28W T8 FL lamps, choose LED tubes that deliver >1900 lm, >100 LPW, >80 CRI, diffuse finish, beam angle >133° .
- Modify every troffer/luminaire in the building with the same lamp and wiring type. Keep 5% spares on hand, so that if one or more lamps fail, you will have the identical wiring lamp on hand. **You do not want maintenance staff mixing up fluorescent and T8 LED lamps, or single-end-wired with double-end-wired LED lamps.**



LED Tubes, Kits, Troffers: Should You Upgrade?

If you use **LED troffer kits**:

- LED kits can be good if well-engineered, but MAY NOT save you much energy unless you drop light levels
- Check that the kit is NRTL approved and complies with UL1598C
- Check to see if there is any limitation on which manufacturers' troffers can be used, or depth of troffer
- Look for **70LPW** or higher on kit as *installed*

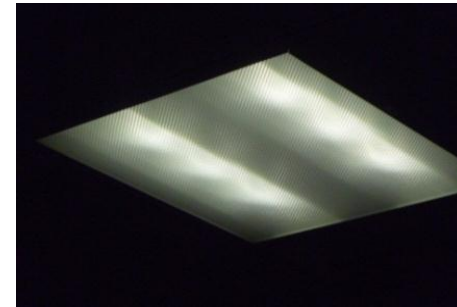


LED Tubes, Kits, Troffers: Should You Upgrade?

If you use new **LED troffers**:

- Luminaire efficacy is very high. Look for **90+ LPW**
- Dramatic brightness patterns on lenses can be very distracting (AND glaring) from some products, so see them first
- Color ranges all over the map, but most products are as good *or better* than FL
- Flicker is a problem with some LED DRIVERS when dimming and there is no complete metric at this point in time
- Dedicated LED troffers are an excellent option for new installations

See 'em, mock 'em up, before you buy a bunch of them



LED Tubes, Kits, Troffers: Should You Upgrade?

Better Buildings Alliance – LED Troffer specification

- Target minimum luminaire efficacy of 85 LPW
- 5 year warranty
- PF>.90 THD <20%
- Driver efficiency >80% for <50W
- Minimum luminaire lumens:
 - 1 × 4 - 1,500 initial lumens
 - 2 × 2 - 2,000 initial lumens
 - 2 × 4 - 3,000 initial lumens
- Minimum SC of 1.0-2.0 in both planes
- CRI >80 with R_g >0
- Lumen maintenance >77.4% @ 36,000 hours

BBA spec available at:

http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/high_efficiency_troffers_spec.pdf

Questions? Discussion?

For Tubes, Kits, Luminaires: Weighing the Options for Troffer Upgrades

Link to

[Upgrading Troffer Luminaires Fact Sheet](#)

Links to CALiPER reports on

[LED Troffer Lighting](#) and [Linear LED tubes](#)



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